SELECTION OF *DROSOPHILA* ALTERED BEHAVIOUR AND AGING STRAINS FOR MICROGRAVITY RESEARCH

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ABSTRACT

Some years ago Prof. Marco and his team discovered that *Drosophila* show noticeably different behaviour as well as accelerated aging in Space (1-4). It was also proven that by simulating these conditions on Earth, it was possible to replicate these phenomena (2,5,6). In order to demonstrate how closely connected the enhanced motility and the accelerated aging are, five *Drosophila* strains have been selected, each behaving differentially under altered gravity conditions. Three of these strains have been selected some years ago and re-selected over the last six months according to their gravitropic response in a vertically-oriented ten-exit maze for 25 generations. The behaviour of flies at 1g resembles an exaggerated escape response to gravity, a neutral behaviour to gravity and a negative (attractive) behaviour to gravity, respectively. The other two strains have been selected over several decades according to the longevity of their parents to experimentally produce a short and a long-life strain. The five selected strains are scored against a gravitropic index, median survival and median motility in 1g conditions to evaluate their usability as microgravity research tools. Preliminary experiments have been performed at ESTEC/DESC altered gravity facilities (hypergravity and simulated microgravity). The establishment of these strains will provide science with an exciting new tool in Space Biology and their future utilization on space missions or long term stays in the International Space Station is promising.

1. PREVIOUS RESULTS ON DROSOPHILA BEHAVIOUR AND AGING IN SPACE

Previous experiments in space (unmanned satellites, space shuttle or the International Space Station, ISS), have shown that adult *Drosophila* flies change their motile behaviour in microgravity. A consistent increase in motility was found in these experiments, but mature flies (two week-old individuals) showed less increase in motility than recently hatched flies (2). In addition to space flight, we have performed centrifugation and magnetic levitation experiments. Flies locomotor activity is enhanced under microgravity (effective force 0g*) and repressed under hypergravity (2g*), but both altered environments have a negative impact in the overall survival (5,6).

2. SELECTION OF THE ALTERED GRAVITY STRAINS (A, M AND B STRAINS)

Representative numbers of male imagoes (up to 200 individuals) from each strain were introduced into a vertically-oriented ten-exit maze for the selection process, following previous established methods (7). Those imagoes coming out of the corresponding exits for the selected strain were crossed with virgin females in order to transmit the selected gravitational character to the offspring. This process was repeated over several generations until a notable percentage of flies show the desired gravitational behaviour.

An initial selection carried out in 2003 over 20 generations showed a different behavior among the three strains (Fig.1). The corresponding trend for each strain is being recovered through a re-selection process in 2010.

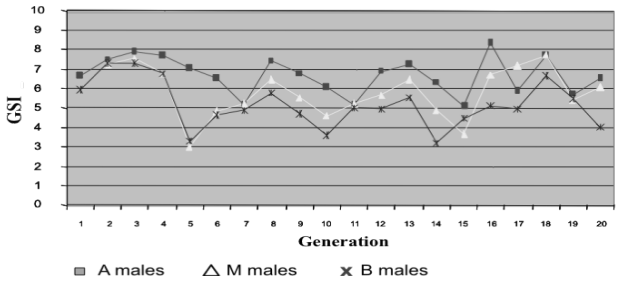


Fig.1a

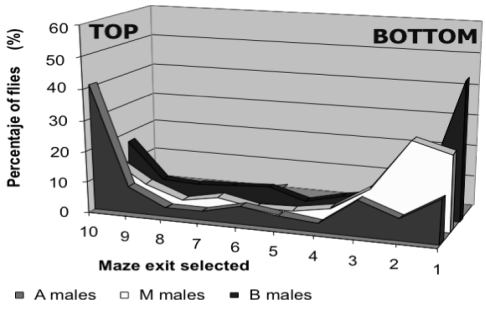
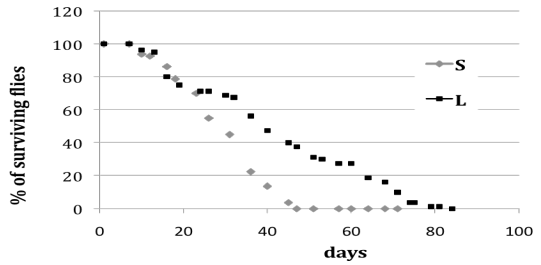


Fig.1b

Fig.1. 1a. Geotaxic Selection Index (GSI) evolution during the reselection of A, M and B strains. Percentage of flies coming out of the different exits considering 100% as the number of flies introduced in the maze in every round. 1b. Percentage of flies from generation 20 coming out through the different exits.

3. SELECTION OF THE ALTERED SURVIVAL STRAINS (S AND L STRAINS)

Selection has been based on the recovery of the offspring according to the longevity of their parents. Eggs from the short-life strain are taken from <1 week-old imagoes. On the other hand, eggs from the long-life strain are taken as late as possible from 4 to 6 week-old imagoes. This selection strategy has been performed over a couple of decades in our laboratory facilities in Madrid. In 2010, the selection process continues in both strains. Survival has been successfully tested in TEC-MMG facilities at ESTEC, showing a clear difference in median survival times (26.5 vs 41.0 days for S and L strains respectively) (Fig 2).



Median survival	***26.5***	***41.0***
Strain	*S*	*L*

Fig. 2. Survival rates of S and L altered aging strains at 1g.

In addition, climbing activity is a good indicator for vitality and aging. Climbing activity is defined as the percentage of flies able to climb at least 20 cm up a wall in 30 seconds. It shows higher values in L strain than in S strain when comparing young individuals of the same age (not shown).

4. PRELIMINARY RESULTS FROM YOUNG S AND L IMAGOES UNDER HYPERGRAVITY AND SIMULATED MICROGRAVITY

Young imagoes were introduced into two gravimetric devices which are located in laboratory facilities at ESA-ESTEC. One of these devices, the RPM (Random Positioning Machine), is able to create simulated microgravity. The other, the LDC (Large Diameter Centrifuge), generates a 2g effective force. The experiment was ongoing for 72 hours. Then, young imagoes were brought back to 1g and the first measurement was taken 2 hours later. Flies were kept at 1g during monitoring.

Preliminary results from young S and L imagoes suggests opposite behaviors under hypergravity and simulated microgravity conditions. Simulated microgravity created on RPM decreases climbing activity compared to the 1g controls. Hypergravity generated by LDC increases climbing activity compared to the 1g controls. In both cases, the corresponding effects are reversed in a couple of weeks, when the individuals start to age.

5. CONCLUSIONS

Selection of flies with a gravitational / aging altered response is possible and reselection is ongoing in order to refresh the selected phenotype.

Preliminary results with altered aging strains, both in simulated or real conditions, indicate differences in their adaptation and recovery to altered gravitational loads.

Experiments to regain more robust data with the five strains are already ongoing.

6. Acknowledgements

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